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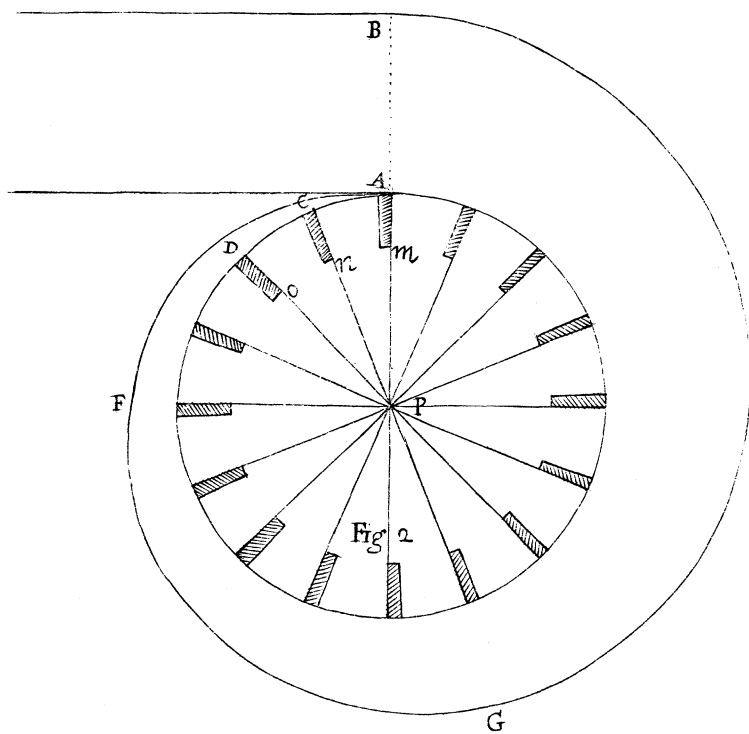
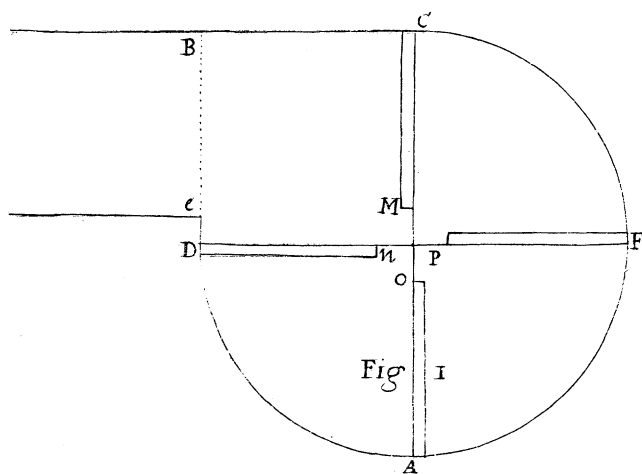
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I. Part of a Letter from Mr D. Papin to Dr Frederick Slare, Fellow of the College of Physicians and of the Royal Society, concerning an Improvement of the Hessian Bellows, &c.

I Am busie at present for a Coal-mine, which hath been left off because of the impurity of the Air: I have therefore improved the *Hessian* Bellows: I don't question but you have seen that new contrivance, printed *Lipsæ in Actis Eruditorum anno 1699.* with this Title, *Rotatilis Suctor & Pressor Hassiacus*: And it may be apply'd for Wind as well as for Water. At that time the shape of the *Tympanum* was Cylindric, as may be seen Fig. 1. where D A F C is the circumference: CP, DP, AP, are the *Radii* which bear the Wings Cm, Dn, Ao: CE is the aperture through which the Wind must be driven in the direction of the Tangent CB: And it may be observ'd that when the Engine is working, every Wing from the end of the aperture E, till it comes to the beginning of the same aperture C, drive always the same Air, with the same swiftness, and at the same distance from the Center: So that in perusing all that circumference, the Air doth find resistance by friction, and gets nothing at all. I do therefore now make the circumference of the *Tympanum* in a Spiral shape, which is to be seen Fig. 2. where the Spiral circumference is A F G B, the *Radii* are AP, CP, DP, &c. The Wings are AM, CN, DO, &c. The aperture is AB. And it is to be observed, that every Wing in going round drives new Air, because the Air which is first in motion finds place to recede from the Center towards the Spiral circumference; and so it gives room to new Air to  
come

come to the Wing: And when the Wings come near to the Aperture, they drive their new Air into the Aperture without any friction; and the Air which hath been first driven and removed from the Wing, cannot lose its swiftness, because the Wings which continually follow do continually drive new Air, which keeps that which is before always in the same swiftness. This new shape of the *Hessian* Bellows affords also another advantage; because the Air in going round follows the Spiral line, which is nearer to the straight line than a Circular circumference; and when the Air comes to the Aperture, it gets into it without any loss of substance; but in the Cylindrical Machine, *Fig. 2.* the Air doth always go round in a Circular circumference; and when it comes to the Aperture, the Wind is driven directly in the direction of the Tangent but just in the beginning at C; and afterwards the Impulsion is oblique: And this obliquity is always increasing until the Wing comes to the *punctum* A: Now it is known how much diminution such an obliquity can make to the strength. I believe therefore that this Spiral figure is a good improvement to this Engine. And indeed I have made such Bellows where the *Radius* AP is but 10  $\frac{1}{2}$  inches, the Wing Am 2 inches broad and 9 inches high; because the *Tympanum* is also so high, or little more; the Aperture AB is also 9 inches, or a little more, so that it makes a square hole. When I work this Engine with my Foot, it makes such a Wind that it may raise up two pounds weight; and without doubt a stronger Man could do much more: But this is more than sufficient for our purpose, since we must but drive Air enough for the respiration of such Men that can work in the Mine; and we may easily with Boards make Wooden Pipes, to carry the Wind to the very bottom: So that the Air within will be continually renewed as well as without.

His Serene Highness being gone to *Shualbach*, I must expect his return to apply the Engine to the Mine; and I hope

hope then I shall be able to impart the success to the Royal Society.

About the Engine, proved before a Committee of Parliament, to demonstrate the power of Water expanded by Fire, I will tell you that we have here made very good Experiments of that matter before Winter. We have raised Water to the height of 70 foot, by a very commodious way, which may be yet very much improv'd; and because his Serene Highness was desirous to see somewhat more, the Engine was left too long in the River, so that the Ice broke it, and carried away part of the same; and since that time other designs have been undertaken, so that this Water Engine is not yet repaired: I hope in time we shall again work about that as well as about a Furnace, to which the *Hessian* Bellows will be very useful. I have already made a little trial of it, and I had a very strong Fire in a Furnace, to melt Glass, Iron, or any other hard Mettal; and yet I could open the Furnace above the matter to be wrought upon, and yet no Flame would get out through the Aperture; nor cold Air from without get into the Furnace: So that it is very like this will be a great conveniency for several sorts of Work, since Men may work the Matters when they are most softened in the Fire; and they may be drawn up Perpendicularly, that they may not be bent, as they are when we draw them Horizontally. I believe that would be good, especially to make easily Glass Pipes and Looking-glasses of an extraordinary bigness. It would be too long to give now the description of these Inventions; and I have made mention of these but by the by, to shew that the *Hessian* Bellows are an Invention that may be apply'd to several good uses, and so that deserve very much to be improved.